(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 January 2002 (10.01.2002)

PCT

(10) International Publication Number
WO 02/03720 A2

(51) International Patent Classification[7]: H04Q 7/00

(21) International Application Number: PCT/US01/21077

(22) International Filing Date: 2 July 2001 (02.07.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/609,517 3 July 2000 (03.07.2000) US

(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET LM ERICSSON (publ)** [SE/SE]; Telefonplan, S-121 65 Stockholm (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BHATIA, Ranjit** [US/US]; 2444 Ravenhurst Drive, Plano, TX 75025 (US). **KRANSMO, Jan** [US/US]; 2504 Deer Horn Drive, Plano, TX 75025 (US).

(74) Agents: **WEATHERFORD, Sidney** et al.; Ericsson Inc., 6300 Legacy, MS EVW 2-C-2, Plano, TX 75024 (US).

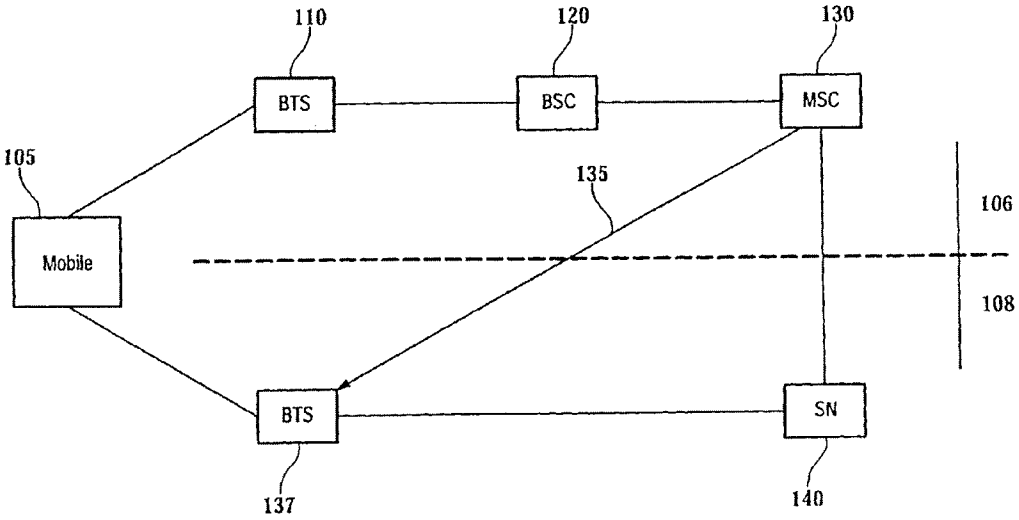
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *without international search report and to be republished upon receipt of that report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) **Title:** SYSTEM AND METHODS FOR PERFORMING A HANDOVER BETWEEN A CIRCUIT SWITCHED ENVIRONMENT AND A PACKET SWITCHED ENVIRONMENT




(57) **Abstract:** The present invention provides a method for performing a handover from a circuit switched environment to a packet switched environment. The method can include receiving a handover request at a mobile switching center located within the circuit switched environment, sending a handover command from the mobile switching center to a mobile device, and transmitting a handover access burst from the mobile device to a signaling node located within the packet switched environment.

WO 02/03720 A2

# SYSTEM AND METHODS FOR PERFORMING A HANDOVER BETWEEN A CIRCUIT SWITCHED ENVIRONMENT AND A PACKET SWITCHED ENVIRONMENT

## TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to the field of telecommunications and more particularly to systems and methods for performing a handover between a circuit switched environment and a packet switched environment.

## BACKGROUND

In the world of telecommunications today, there exists both circuit switched environments and packet switched environments. A switching method in which a direct transmission path between the terminals involved is made available for the duration of a call, regardless of whether information is transmitted or not, is called "circuit switching". A switching method in which the messages are divided into packets and routed through the network link by link with the aid of destination information contained in a packet header is called "packet switching". The packets are stored until a path in a desired direction becomes free.

A typical phenomenon of cellular systems is the change of base stations, i.e., the handover, where a given mobile terminal moves from the transmission range of a first base station to that of a second base station, whereby essentially all the data transmission between the terminal in question and the network is rerouted through the new base station. A perfect synchronization of the operation during the handover is often not possible, which may result in packet loss, duplication or misordering.

Handover between a circuit switched network and a packet switched network increases the difficulty of obtaining synchronous operation during the handover. Thus, a need has arisen for the ability to successfully handover traffic from circuit switched environment to a packet switched environment.

SUMMARY OF THE INVENTION

The present invention provides a method for performing a handover from a circuit switched environment to a packet switched environment. The method can include receiving a handover request at a mobile switching center located within the circuit switched environment, sending a handover command from the mobile switching center to a mobile device, and transmitting a handover access burst from the mobile device to a signaling node located within the packet switched environment.

The present invention also provides a system for performing a handover between a circuit switched environment and a packet switched environment. The system can include one or more mobile switching centers residing in the circuit switched environment. The system may also include one or more signaling nodes residing in the packet switched environment. The signaling nodes can be in communication with the mobile switching center. The system may also include one or more mobile device. The mobile device can be in communication with the mobile switching center and the signaling node. The mobile devices can also be configured to operate in both the circuit switched environment and the packet switched environment.

BRIEF DESCRIPTION OF THE DRAWINGS

**FIGURE 1** is a schematic diagram of an embodiment of a system of the present invention for performing handover between a circuit switched environment and a packet switched environment;

**FIGURE 2** is a schematic diagram of another embodiment of the system of the present invention for performing handover between a circuit switched environment and a packet switched environment;

**FIGURE 3** is a signaling sequence diagram illustrative of a method of the present invention for performing handover between a circuit switched environment and a packet switched environment; and

**FIGURE 4** is a signaling sequence diagram illustrative of another embodiment of a method of the present invention for performing handover between a circuit switched environment and a packet switched environment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 1, a telecommunications system 100 is depicted. The telecommunications system 100 has both a circuit switched environment 106 and packet switched environment 108. The circuit switched environment can be a Public Service Telephone network, an Plane Old Telephone network, or the like. The packet switched environment can be an Internet Protocol network, a Time Division Multiple Access network, or the like. Both environments reside on the Global System for Mobile communication (GSM).

A mobile device 105 is provided in Figure 1. The mobile device 105 can be of operated in both the circuit switched environment and the packet switched environment. The mobile device 105 is in communication with a base transceiver station 110, residing in the circuit switched

environment. The base transceiver station 110 is in communication with a base station controller 120. During the operation of the mobile device 105, the signal strength and quality of the transmissions from the mobile device 105 are continuously measured. These measurements for signal strength and quality, are made on the down link while the mobile device 105 is in busy mode. The serving base transceiver station 110 measures, simultaneously with the measurements by the mobile device, the signal strength and quality of the transmissions of the mobile device 105 on the up link.

After the measurements from the base transceiver station 110 and the mobile device 105 are gathered, they are sent to the base station controller 120. The base station controller is in communication with the base transceiver station. Thus, the measurements from the mobile device 105 are first sent to the base transceiver station 110 and then forwarded from the base transceiver station 110 to base station controller 120. Based upon the results of the measurements taken by the base transceiver station 110 and the mobile device 105, the base station controller 120 can decide if a handover is necessary. Handover simply may refer to the process of changing cells or channels during a call in the GSM. If the base station controller 120 decides that a handover is necessary, the base station controller 120 may then decide which cell or channel should accomadate the handover. The process of determining with cell or channel can perform the handover is called locating.

The base station controller 120 is in communication with the mobile switching center 130. If the base station controller 120 receives measurements indicating that a handover is necessary, the base station controller 120 can

send a message to the mobile switching center 130. Because the telecommunication system 100 comprises both circuit switched and packet switched environments, the base station controller 120 can request that the handover be a packet switched handover. The base station controller 120 can send a packet switched handover message to the mobile switching center 130, resulting in the mobile switching center 130 attempting to complete the handover.

The mobile switching center 130 may be configured to determine the packet switched address for the mobile device 105 and may be further configured to convert the circuit switched message to a packet switched message. Once the mobile switching center 130 determines the packet switched address for the mobile device 105 and determines the corresponding signaling node 140 in the packet switched environment for the mobile device 105, the mobile switching center can send a handover command 135 to the base transceiver station 137, located in the packet switched environment, corresponding to the signaling node. The base transceiver station 137 will then send a handover command, to the mobile device 105. The mobile device 105 may then expect to receive a handover from the circuit switched environment to the packet switched environment.

At this time the mobile device 105 may switch from a circuit switched mode to a packet switched mode. Once the mobile device 105 has entered a packet switched mode, the mobile device 105 can send an access burst back to the signaling node 140. After the signaling node 140 receives the access burst from the mobile device 105, the signaling node 140 sends a request to the mobile switching center 130 asking the mobile switching center to transmit the circuit switched message, or to handover the message. The mobile switching center 130 may then be adapted to convert the

message from circuit switched to a packet switched message and send the packet switched message to the signaling node 140. Once the signaling node 140 receives the packet switched message, the signaling node 140 will transmit the message, on the packet channel indicated by the access burst sent from the mobile device 105.

Referring now to Figure 2, another embodiment of the system of the present invention is generally depicted as 200. The system comprises a mobile device 205 in communication with circuit switched environment 106 and a packet switched environment 108. The circuit switched environment contains a base transceiver station 210 in communication with a base station controller 215, which, in turn, may be in communication with a mobile switching center 225. The mobile switching center 225 can be in communication with a database 230. The database 230 can store information regarding the packet switched addresses of mobile devices, such as mobile device 205. Similarly, the mobile switching center 225 can be in communication with a gateway 250. The gateway 250 can be a media gateway. The gateway 250 can be configured to convert circuit switched message to packet switched messages. The packet switched environment comprises a signaling node 245 and a base transceiver station 240. The signaling node 245 and the base transceiver station 240 can be in communication with each another.

Once the base station controller 215 determines that a handover may be needed for mobile device 205, the base station controller sends a handover request to the mobile switching center 225. When the mobile switching center 225 receives the handover request 220, the mobile switching center 225 sends an address request to the database 230 to determine the packet switched address for the mobile device

205. The database 230 then returns a message to the mobile switching center 225 indicating the correct packet switched address for mobile device 205 and the corresponding signaling node 245 for the mobile device 205. The packet switched address can be an Internet Protocol address, an x.25 address or the like.

The mobile switching center 225 can then send a handover command to the base transceiver station 240, located inside the packet switched environment 208. The handover command can be forwarded to the mobile device 205 by the base transceiver station 240. The mobile device 205 may then send an access burst to its corresponding signaling node 245, as indicated by line 260. The signaling node 245 can then transmit a request to the mobile switching center 225 asking that the messages be sent to the signaling node 245.

The mobile switching center 225 may send the message to a gateway 250. The gateway can convert the message from a circuit switched message to packet switched message, and then forward the message to the signaling node 245. Once the packet switched messages are received by the signaling node 245, the signaling node 245 transmits the packet switched messages to the mobile device 205.

Referring to Figure 3, a signaling sequence illustrative of a method of performing a handover from a circuit switched environment to a packet switched environment is shown. As indicated in Figure 3, there are four major components needed to perform the handover from the circuit switched environment to the packet switched environment. The components are a base station controller 305, a mobile switching center 310, a signaling node 315, and a mobile device 320. The components all have features

similar to those described above in regards to Figures 1 and 2.

As shown by Figure 3, a packet switched handover request 325 is sent from the base station controller 305 to the mobile switching center 310. The base station controller 305 sends the packet switching handover request when it is determined through measurements that a mobile device 320 can no longer transmit signals efficiently in its current state. When the mobile switching center 310 receives the packet switching handover request 325, the mobile switching center 310 sends a packet switching handover command 330 to the mobile device 320. The packet switching handover command 330 does not go through the signaling node 315. Rather, the packet switching handover command 330 is a direct communication between the mobile switching center 310 and the mobile device 320.

After the mobile device 320 receives the packet switching handover command 330, the mobile device transmits an access burst 335 to the signaling node 315. The access burst indicates the packets channel that may be available for the handover from the mobile switching center 310. Once the signaling node 315 receives the access burst 335, the signaling node 315 sends a routing request 340 to the mobile switching center 310 asking the mobile switching center 310 to send the message, or handover, the message, to the signaling node 315. After the mobile switching center 310 receives the routing request, the mobile switching center 310 may route 345 the message to the signaling node 315. The message can be converted, from a circuit switched message to a packet switched message, either at the mobile switching center 310 or at the signaling node 315 depending upon the configurations of each. Once the message is received 350 by the mobile

device 320, the mobile device 320 sends a handover complete message 355 to the base station controller 305.

Referring now to Figure 4, a signaling sequence illustrative of another embodiment of a method of the present invention is generally depicted. Again, a base station controller 400, a mobile switching center 410, a signaling node 420, and a mobile device 430 are provided. In addition, a database lookup 415 and a base transceiver station 425 are also provided. When the base station controller 400 determines that a handover is needed for the mobile device 430, the base station controller 405 sends a packet switched handover request 435 to the mobile switching center 410. When the mobile switching center 410 receives the handover packet switched request 435, the mobile switching center 410 sends a packet switched address request 440 to the database lookup 415 asking for the packet switched address corresponding to the mobile device 430. The database lookup 415 returns a message 445 to the mobile switching center 410. The return message 445 can contain the packet switched address of the mobile device 430 and the corresponding signaling node 420.

After the mobile switching center 410 receives the return message 445 from the database lookup 415, the mobile switching center 410 sends a packet switched handover command 450 to the base transceiver station 425 residing in the packet switched environment. The base transceiver station 425 will then send the packet switched handover command 455 to the mobile device 430. After the mobile device 430 receives the packet switched handover command 455, the mobile device 430 transmits an access burst 460 to the signaling node 420. Once the signaling node 420 receives the access burst 460, the signaling node 420 can request 465 that the message be sent from the mobile

switching center 410. The mobile switching center 410 will then transmit 470 the message to the signaling node 420. The signaling node 420 will, in turn, transmit 4475the message through the base transceiver station 425 to the mobile device 430. After the message is received at the mobile device 430, the mobile device 430 will transmit a handover complete message 480 to the original base station controller 400.

WHAT IS CLAIMED IS:

1. A method for performing a handover from a circuit switched environment to a packet switched environment, the method comprising the steps of:
receiving a handover request at a mobile switching center located within the circuit switched environment;
sending a handover command from the mobile switching center to a mobile device; and
transmitting a handover access burst from the mobile device to a signaling node located within the packet switched environment.

2. The method of claim 1 further comprising the step of routing a message from the circuit switched environment to the packet switched environment.

3. The method of claim 2 wherein the step of routing includes instructing the mobile switching center to send the message to the signaling node.

4. The method of claim 2 wherein the step of routing includes converting the message from a circuit switched message to a packet switched message.

5. The method of claim 4 wherein the step of converting is performed by a gateway.

6. The method of claim 5 wherein the gateway is a media gateway.

7. The method of claim 1 wherein the signaling node is a serving General Packet Radio Service signaling node.

8. The method of claim 1 wherein the mobile device operates using General Packet Radio Service system.

9. The method of claim 1 wherein the packet switched environment is a Time Division Multiple Access environment.

10. The method of claim 1 wherein the packet switched environment is an Internet Protocol environment.

11. The method of claim 1 wherein the packet switched environment is a X.25 environment.

12. The method of claim 1 further comprising the step of identifying the mobile device for which a handover is required.

13. The method of claim 12 wherein the step of identifying further includes determining the packet switch address of the mobile device.

14. The method of claim 13 wherein the packet switch address is an Internet Protocol address.

15. The method of claim 13 wherein the packet switch address is a X.25 address.

16. The method of claim 13 wherein the step of determining is performed using a database.

17. A system for performing a handover between a circuit switched environment and a packet switched environment comprising:

at least one mobile switching center residing in the circuit switched environment;

at least one signaling node residing in the packet switched environment, the signaling node being in communication with the mobile switching center; and

at least one mobile device, the mobile device being in communication with the mobile switching center and the signaling node and being configured to operate in both the circuit switched environment and the packet switched environment.

18. The system of claim 17 wherein the mobile switching center is configured to convert circuit switched messages to packet switched messages.

19. The system of claim 17 wherein the signaling node is configured to convert circuit switched messages to packet switched messages.

20. The system of claim 17 wherein the signaling node is a serving GPRS signaling node.

21. The system of claim 17 wherein the mobile device operates on the General Packet Radio Service system.

22. The system of claim 17 wherein the packet switched environment is an Internet Protocol environment.

23. The system of claim 17 wherein the packet

switched environment is an X.25 environment.

24. The system of claim 17 wherein the packet switched environment is a Time Division Multiple Access environment.

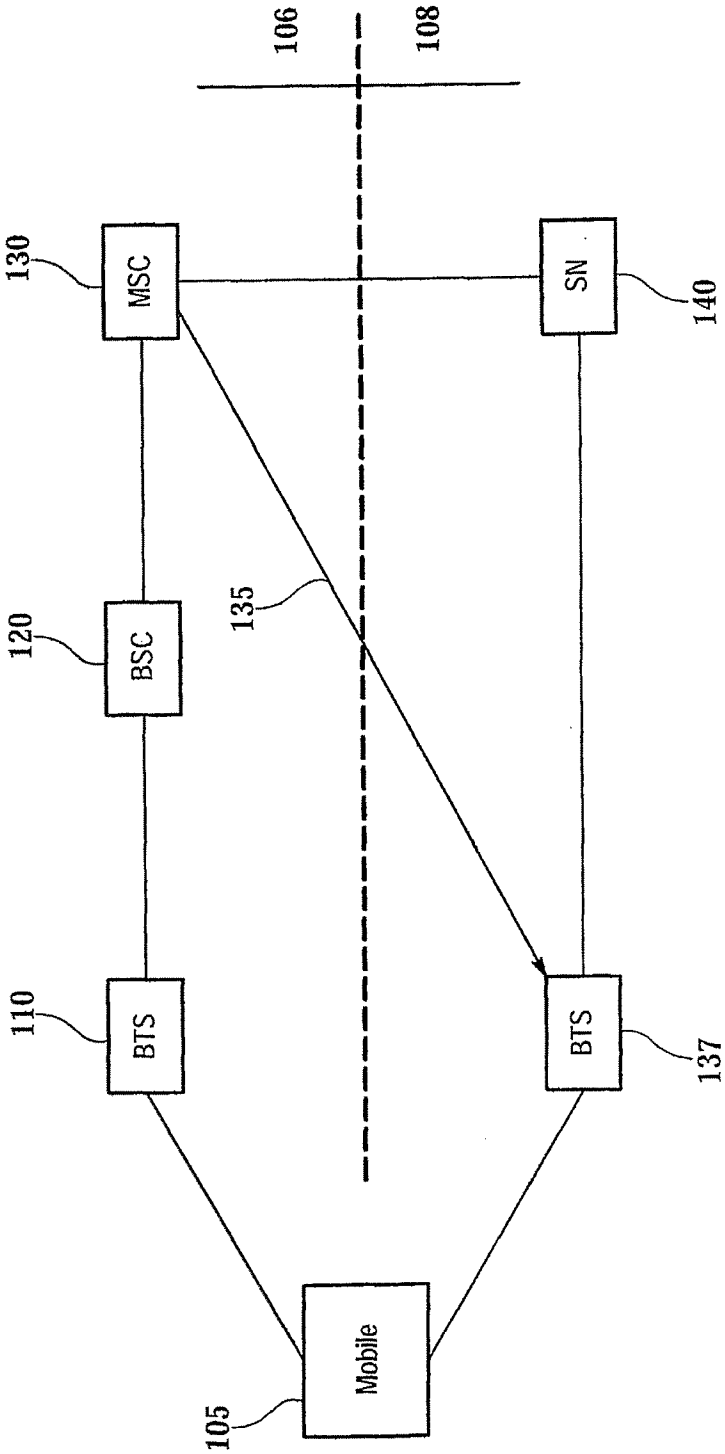



*Fig.1*

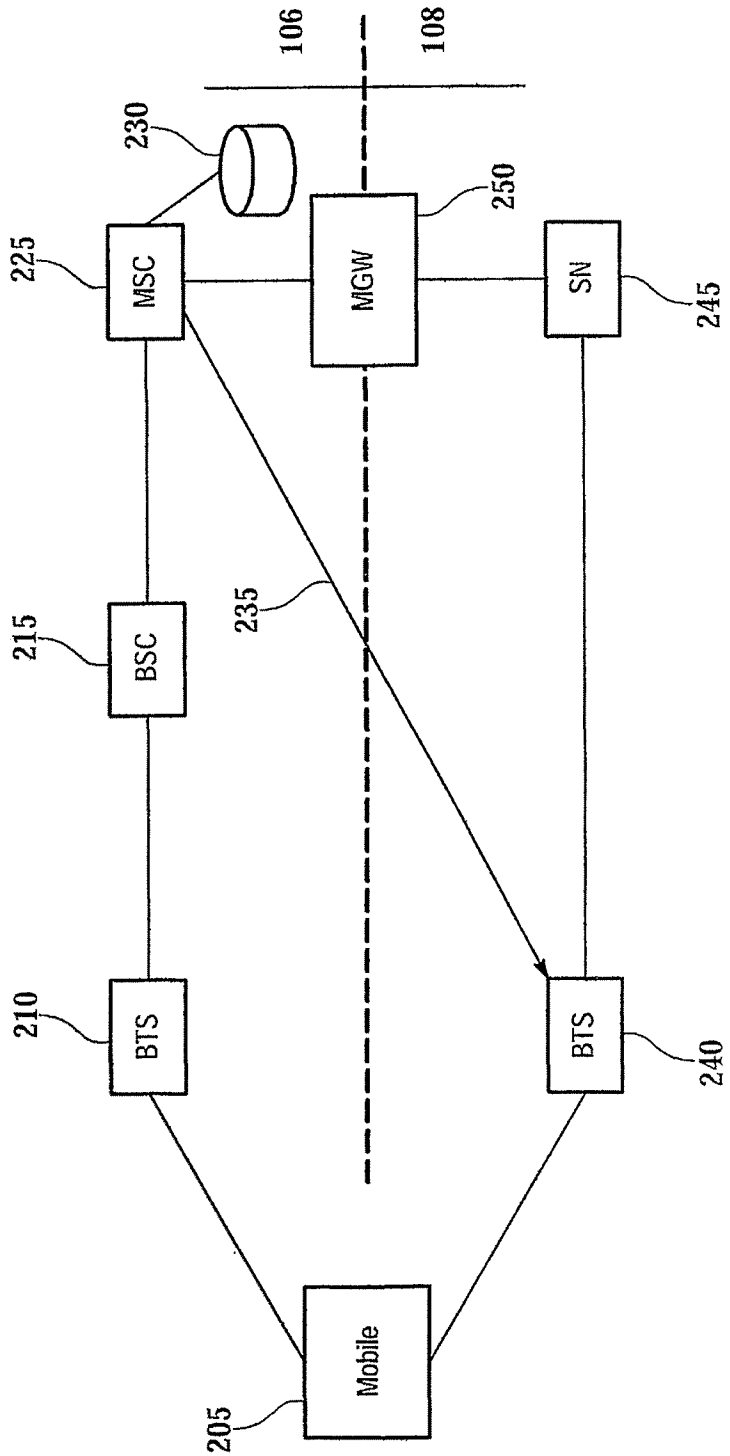

106
108
230
250
225
MSC
MGW
SN
245
235
215
BSC
210
BTS
BTS
240
Mobile
205

*Fig.2*

*Fig.3*

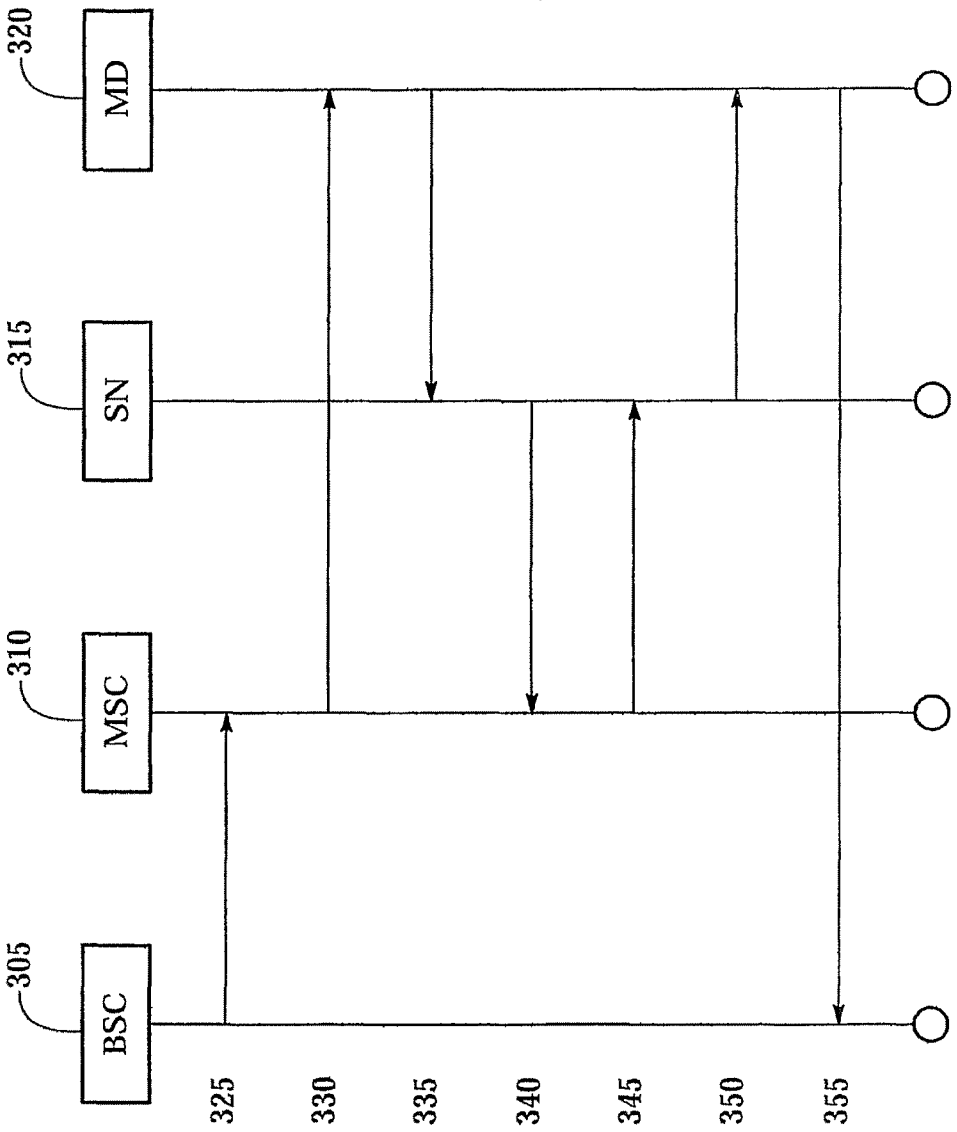
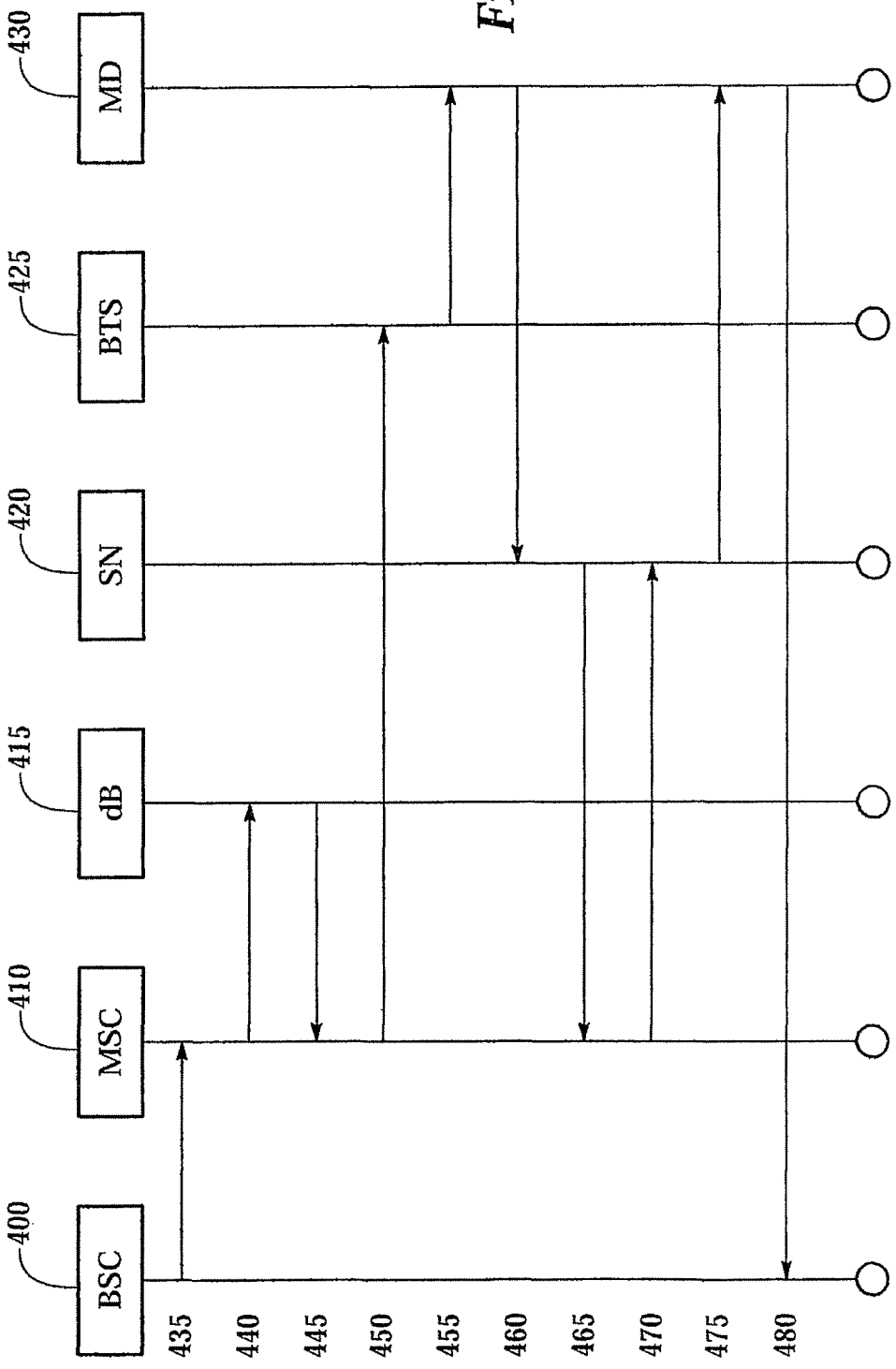


*Fig.4*


400
BSC
410
MSC
415
dB
420
SN
425
BTS
430
MD
435
440
445
450
455
460
465
470
475
480

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 January 2002 (10.01.2002)

PCT

(10) International Publication Number
WO 02/03720 A3

(51) International Patent Classification[7]: H04Q 7/38

(21) International Application Number: PCT/US01/21077

(22) International Filing Date: 2 July 2001 (02.07.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/609,517 3 July 2000 (03.07.2000) US

(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET LM ERICSSON (publ)** [SE/SE]; Telefonplan, S-121 65 Stockholm (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BHATIA, Ranjit** [US/US]; 2444 Ravenhurst Drive, Plano, TX 75025 (US). **KRANSMO, Jan** [SE/US]; 2504 Deer Horn Drive, Plano, TX 75025 (US).

(74) Agents: **WEATHERFORD, Sidney** et al.; Ericsson Inc., 6300 Legacy, MS EVW 2-C-2, Plano, TX 75024 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

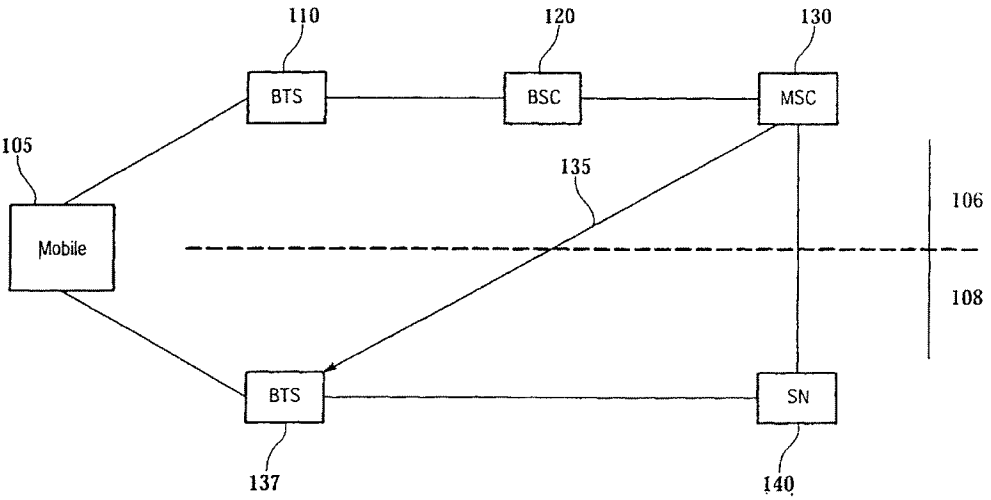
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
2 May 2002

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: SYSTEM AND METHODS FOR PERFORMING A HANDOVER BETWEEN A CIRCUIT SWITCHED ENVIRONMENT AND A PACKET SWITCHED ENVIRONMENT




(57) Abstract: The present invention provides a method for performing a handover from a circuit switched environment to a packet switched environment. The method can include receiving a handover request at a mobile switching center located within the circuit switched environment, sending a handover command from the mobile switching center to a mobile device, and transmitting a handover access burst from the mobile device to a signaling node located within the packet switched environment.

WO 02/03720 A3

# INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 01/21077

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| P,X | WO 01 31963 A (ERICSSON TELEFON AB L M)<br>3 May 2001 (2001-05-03)<br>page 2, line 18 -page 3, line 20<br>page 5, line 8 -page 7, line 3<br>abstract; claims 1-6 | 1,2,7,8,<br>17,20,21 |
| A | WO 99 52307 A (ERICSSON TELEFON AB L M)<br>14 October 1999 (1999-10-14)<br>page 9, line 10 -page 12, line 7<br>figure 1 | 1-24 |
| A | WO 99 63774 A (ERICSSON TELEFON AB L M)<br>9 December 1999 (1999-12-09)<br>abstract; figures 2-4 | 1-24 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 6 March 2002 | 12/03/2002 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016 | Pacholec, D |

1

Form PCT/ISA/210 (second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Interr nal Application No
PCT/US 01/21077

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| WO 0131963 A | 03-05-2001 | AU 1317201 A | 08-05-2001 |
| | | WO 0131963 A1 | 03-05-2001 |
| WO 9952307 A | 14-10-1999 | AU 3857199 A | 25-10-1999 |
| | | CN 1304619 T | 18-07-2001 |
| | | EP 1066729 A1 | 10-01-2001 |
| | | WO 9952307 A1 | 14-10-1999 |
| WO 9963774 A | 09-12-1999 | AU 4666399 A | 20-12-1999 |
| | | BR 9910872 A | 06-03-2001 |
| | | WO 9963774 A1 | 09-12-1999 |